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(54) **Production control system**

(57) In a production control system eg in a factory, a position recognition system determines the positions of the interacting parts 3, 4, 13, 14, 15, 16 of the production process eg products, parts, carrying and fabricating equipment, and their relative movement is controlled in dependence upon a comparison of the detected positions with a stored production plan.

The position recognition means may comprise at least 3 transmitters or receivers 5 located around the production area which exchange data with receivers or transmitters on the interacting parts and the control unit 9, and may operate on a differential time of arrival principle.

A fixed transmitter or receiver 12 can be included to correct the position of each of the floor transmitters or receivers.

The system can be used for operational analysis eg fault diagnosis.

FIG. 1A

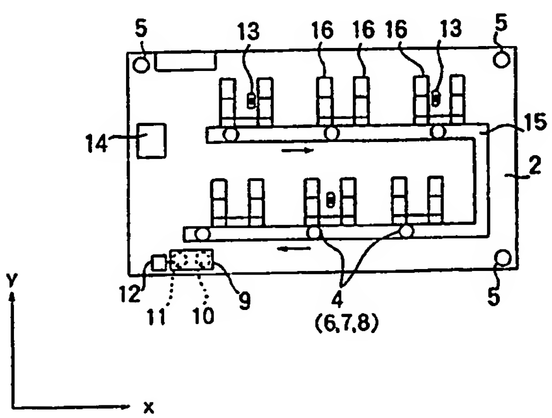

FIG. 1B

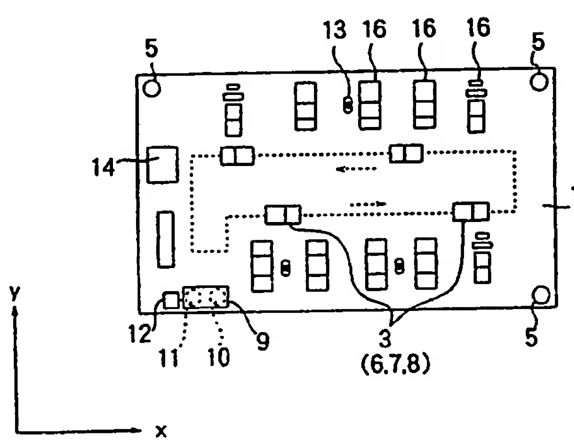

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FIG. 1A

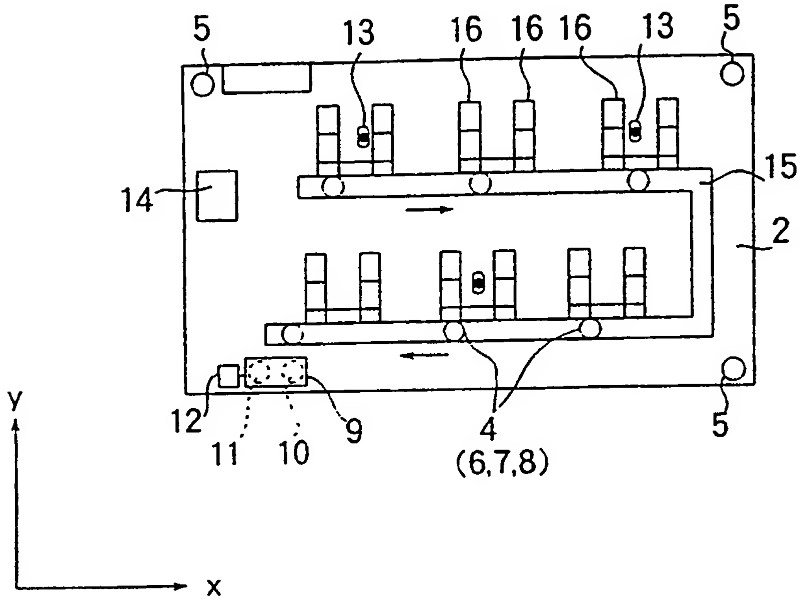

5
13
16
16
16
13
5
15
14
2
12
11
10
9
4
(6,7,8)
5
Y
x

FIG. 1B

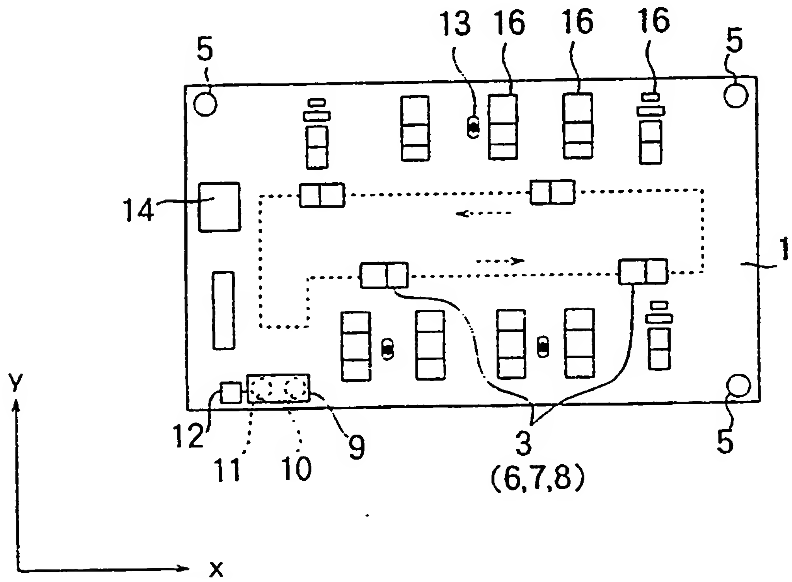

5
13
16
16
16
5
14
1
12
11
10
9
3
(6,7,8)
5
Y
x

FIG. 2

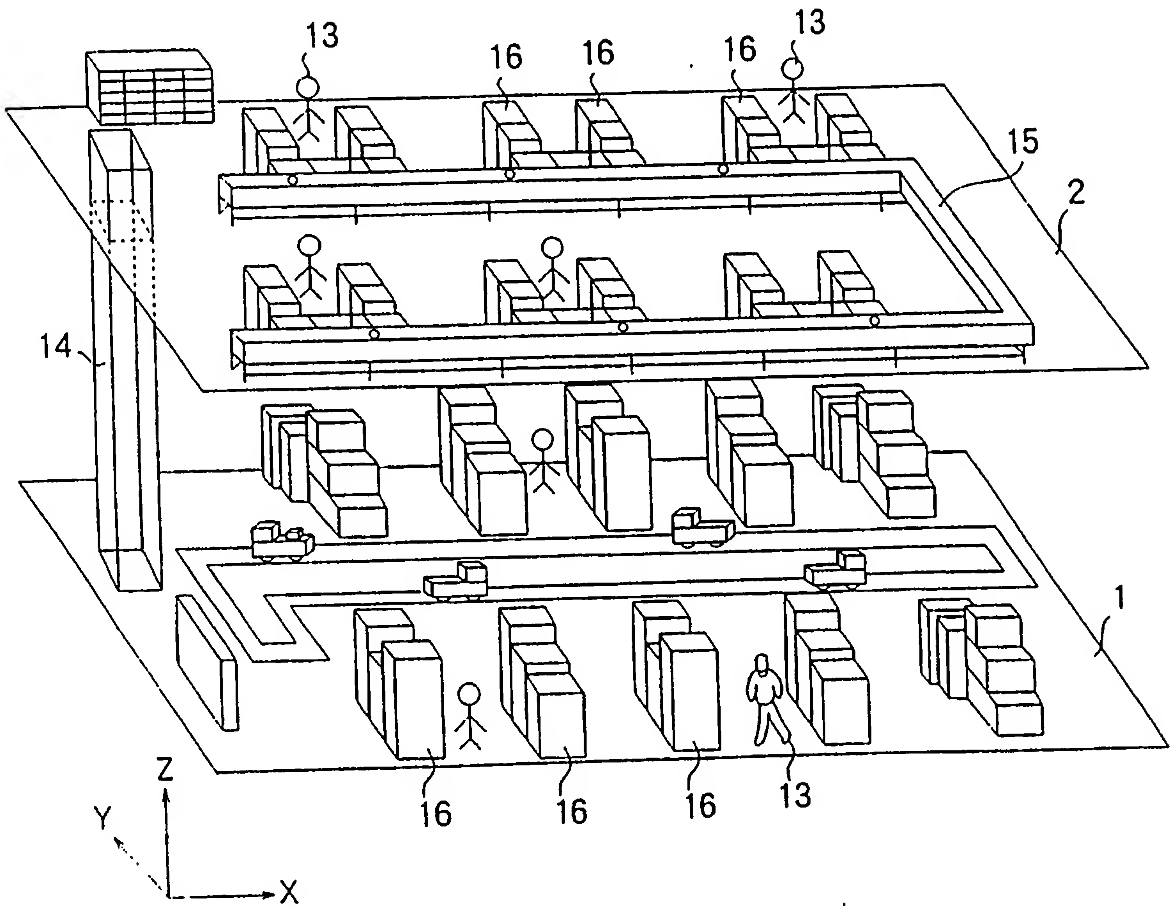


FIG. 3

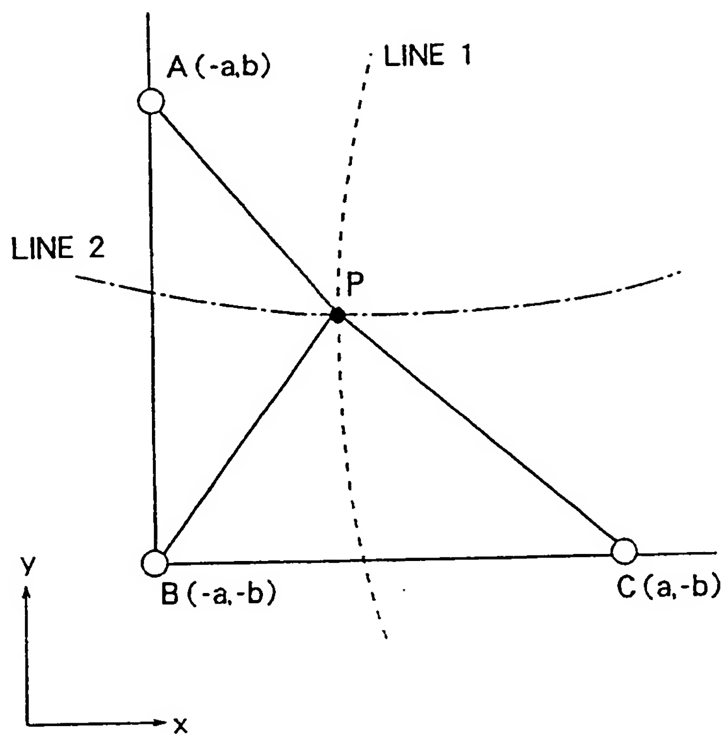


FIG. 4A

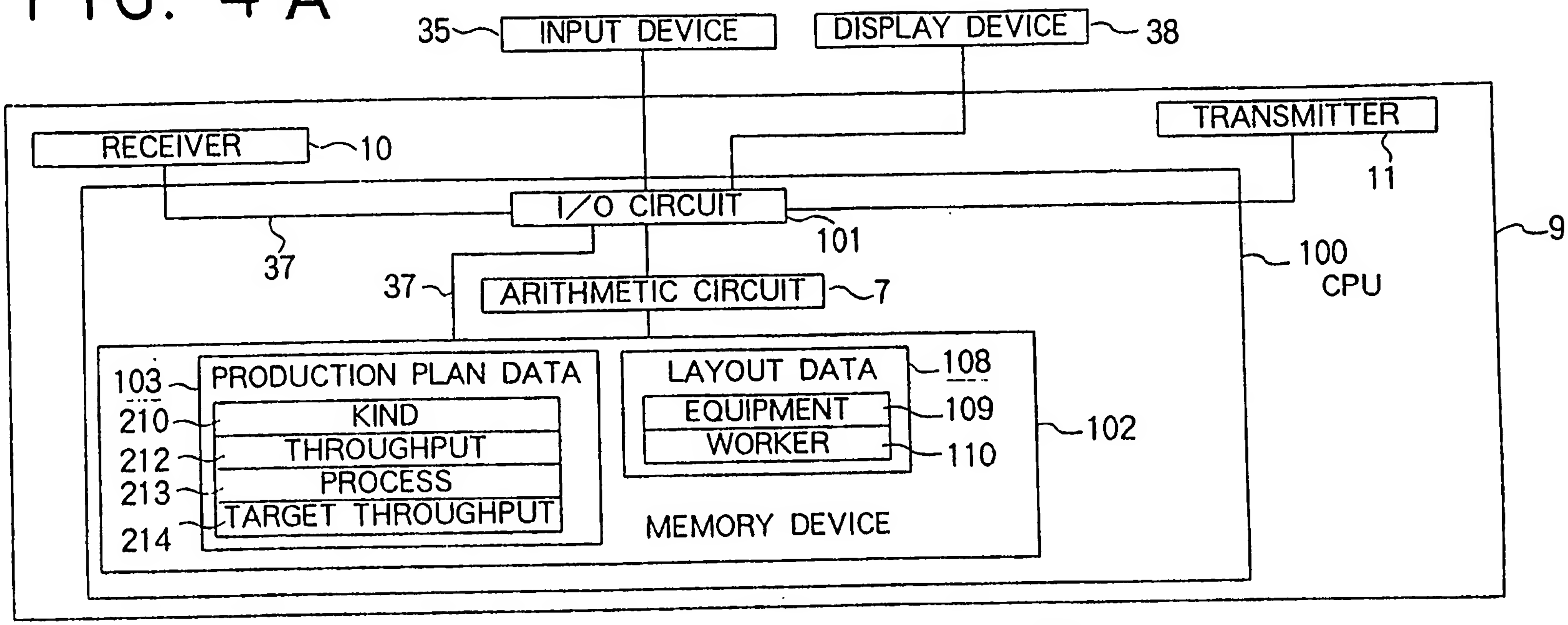

35
INPUT DEVICE
DISPLAY DEVICE
38
RECEIVER
10
TRANSMITTER
11
I/O CIRCUIT
101
37
37
ARITHMETIC CIRCUIT
7
100
CPU
9
103
PRODUCTION PLAN DATA
210
KIND
212
THROUGHPUT
213
PROCESS
214
TARGET THROUGHPUT
LAYOUT DATA
108
EQUIPMENT
109
WORKER
110
102
MEMORY DEVICE

FIG. 4B

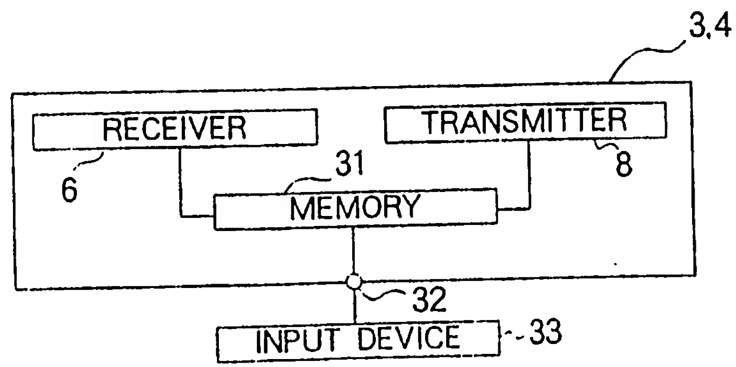

3,4
RECEIVER
6
TRANSMITTER
8
31
MEMORY
32
INPUT DEVICE
33

FIG. 5

OBJECT	CODE DATA (201)		PHASE DATA (202)			POSITION DATA (203)
PRODUCT	001	005	10A	734	321	
WORKER	102	00A	223	481	554	
EQUIPMENT	201	112	587	981	698	

KIND NUMBER 208
REFERENCE NUMBER 204
POINT A 205
POINT B 206
POINT C 207

FIG. 6

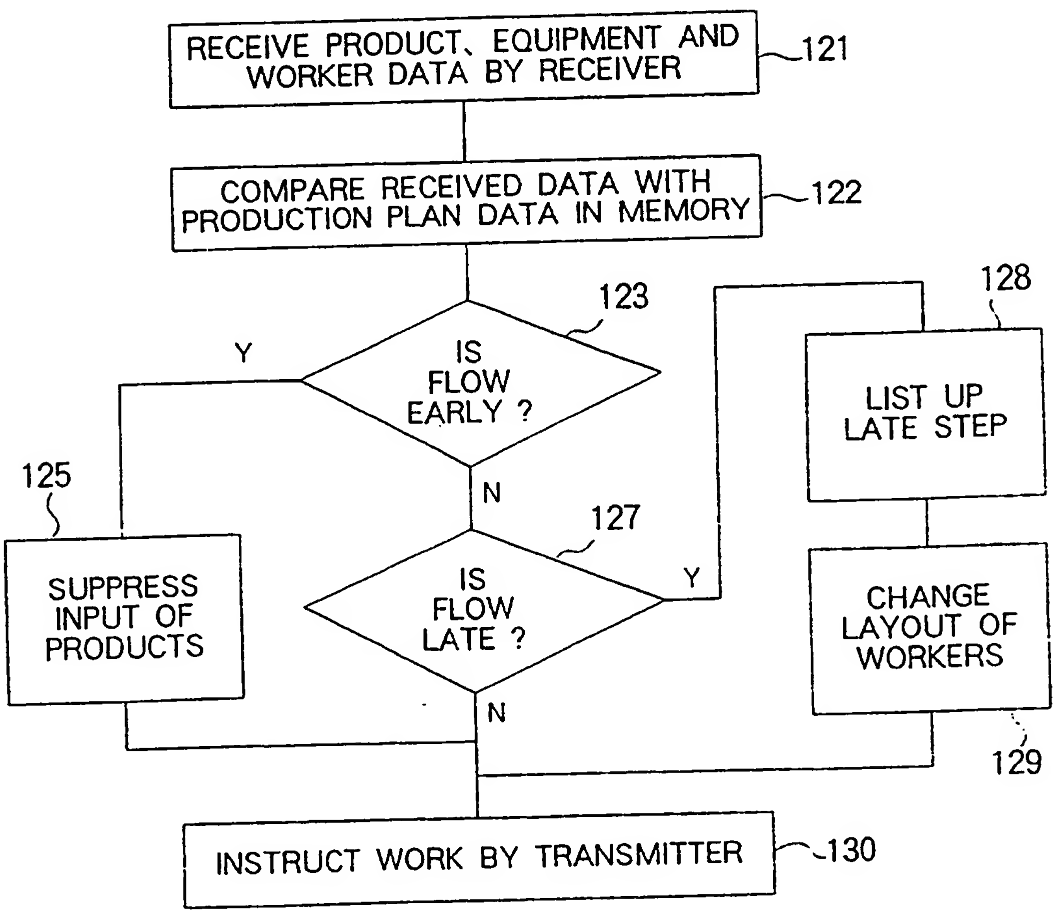


FIG. 7

KIND		0 0 1	INSTANT	10 : 30
		SCHEDULED	ACTUAL	
PRESENT THROUGHPUT OF ONE DAY		320	340	
PROCESS	A (001060659)	8 : 40	○	
	B (051069659)	9 : 00	○	
	C (10A728659)	10 : 10	X	
	⋮			
TOTAL TARGET THROUGHPUT OF ONE DAY		1500	340	

FIG. 8

CODE	COORDINATE	INSTRUCTION
102011	10A728659	OA (MOVEMENT)

X Y Z

FIG. 9

WORKER (CODE)	ARRANGEMENT POSITION			PRESENT POSITION			JUDGEMENT
	X	Y	Z	X	Y	Z	
D (10200A)	223	481	659	223	481	659	○
E (102011)	358	627	659	358	248	659	X
F (102012)	641	293	659	641	293	659	○
⋮		⋮			⋮		⋮

FIG. 10

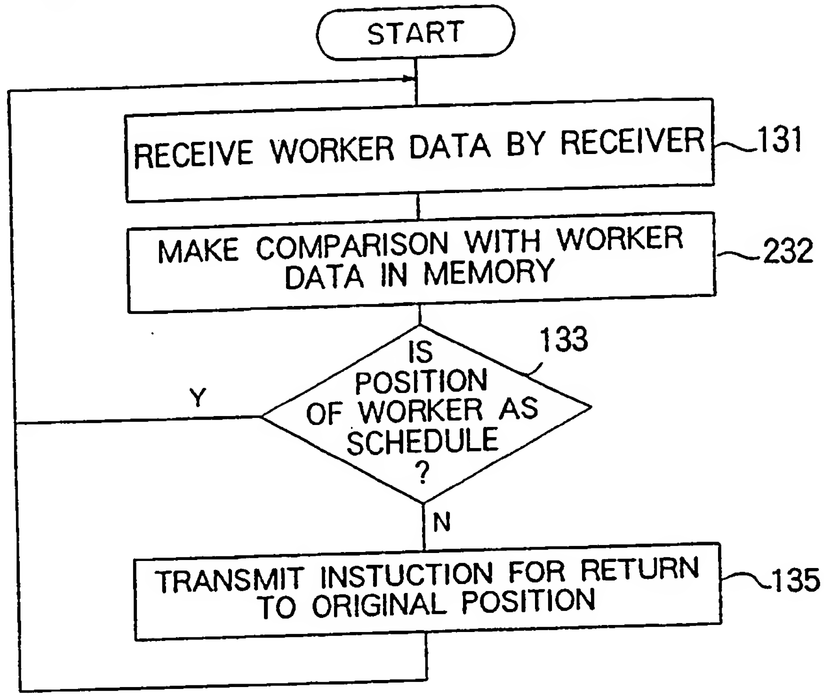

START
RECEIVE WORKER DATA BY RECEIVER
131
MAKE COMPARISON WITH WORKER DATA IN MEMORY
232
IS POSITION OF WORKER AS SCHEDULE ?
133
Y
N
TRANSMIT INSTUCTION FOR RETURN TO ORIGINAL POSITION
135

FIG. 11

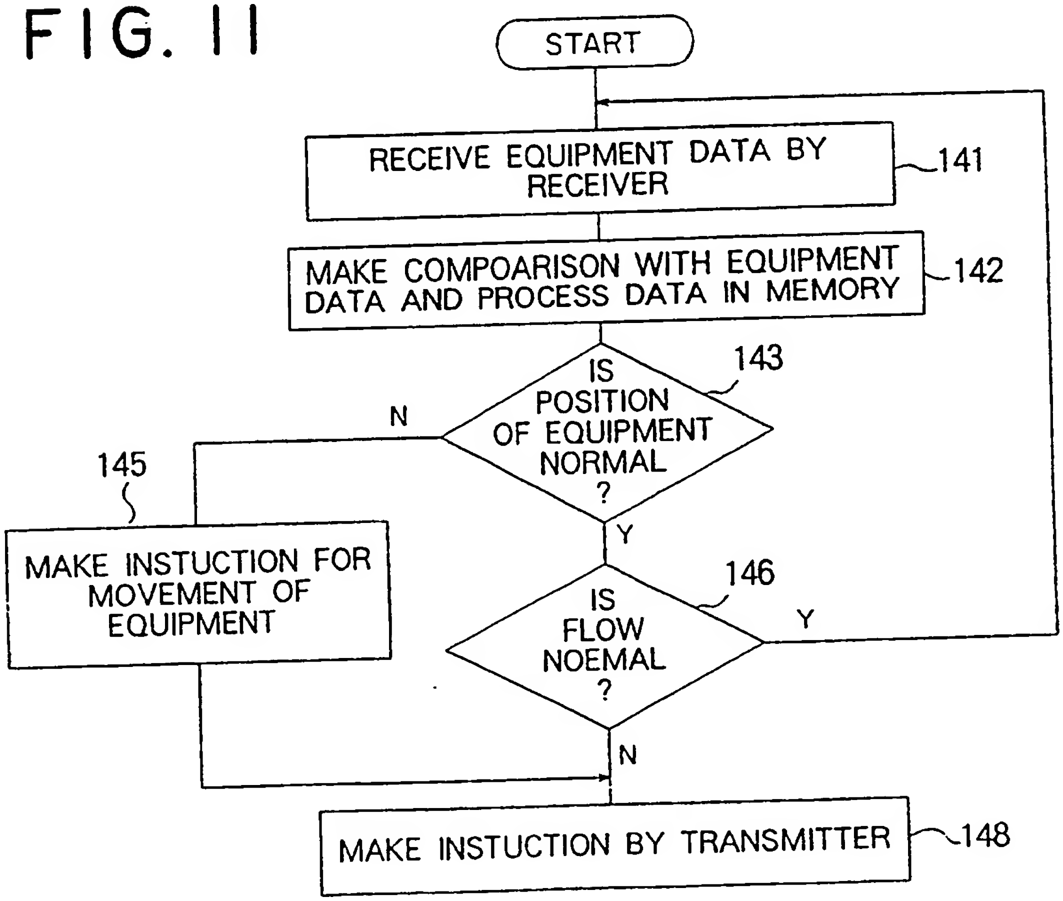

START
RECEIVE EQUIPMENT DATA BY RECEIVER
141
MAKE COMPOARISON WITH EQUIPMENT DATA AND PROCESS DATA IN MEMORY
142
IS POSITION OF EQUIPMENT NORMAL ?
143
N
Y
145
MAKE INSTUCTION FOR MOVEMENT OF EQUIPMENT
IS FLOW NOEMAL ?
146
Y
N
MAKE INSTUCTION BY TRANSMITTER
148

FIG. 12A

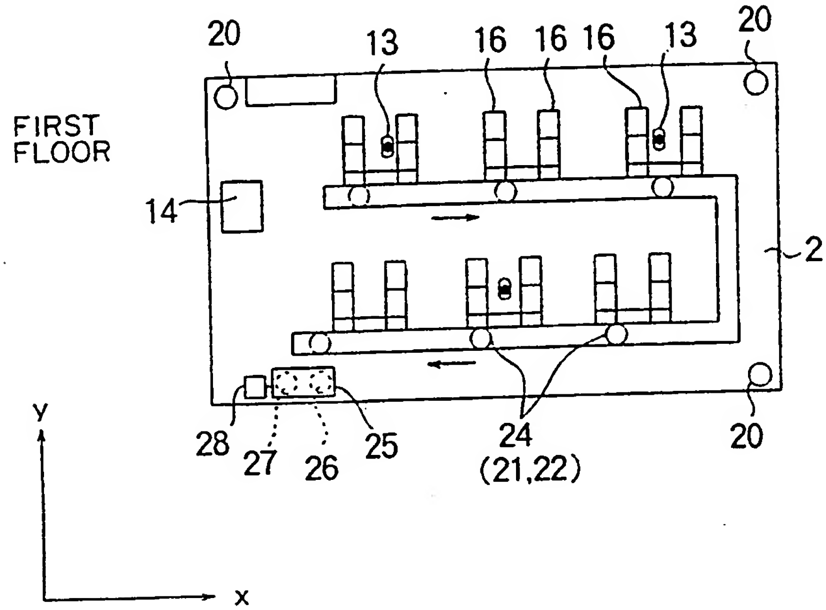


FIG. 12B

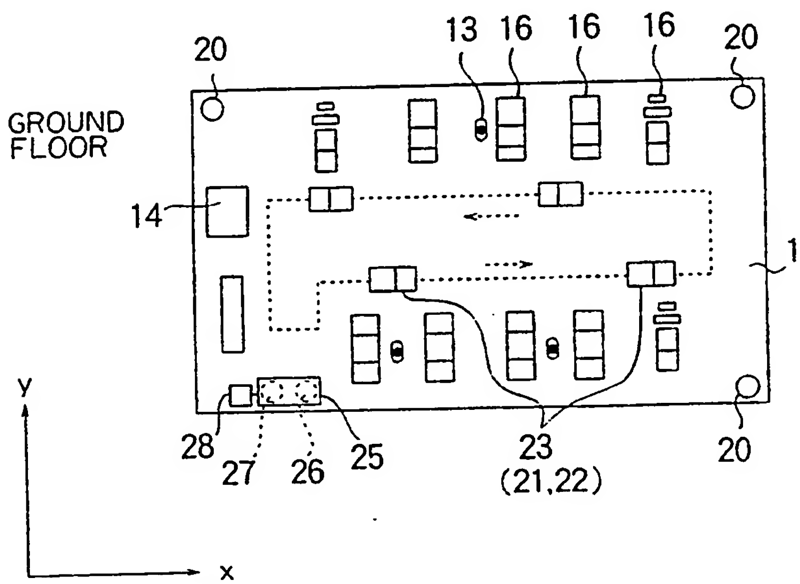
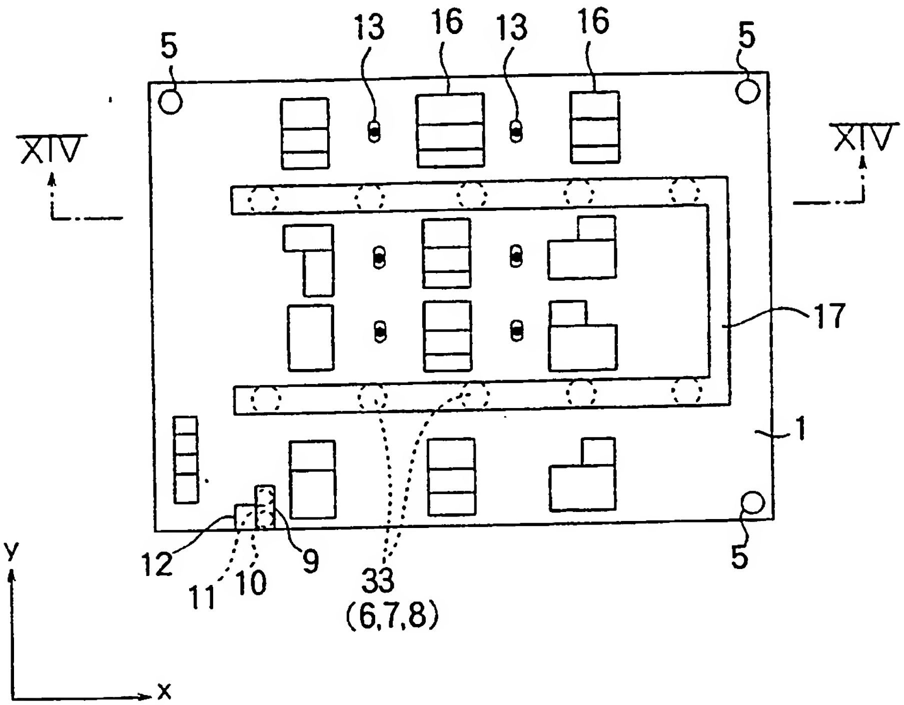
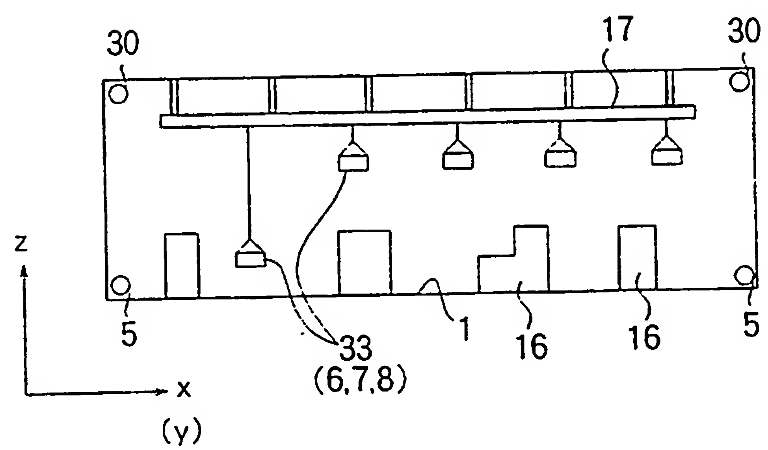


FIG. 13



5
13
16
13
16
5
XIV
XIV
17
1
5
y
12
11
10
9
33
(6,7,8)
x

FIG. 14



30
17
30
z
5
33
(6,7,8)
1
16
16
5
x
(y)

2274521

PRODUCTION CONTROL SYSTEM

The present invention relates to a system for making the positional recognition and control of physically distributed equipments or objects in a processing (or working) line, an assembly line or the like in a factory (or shop) which include products to be physically distributed or carried, and physical-distribution related equipments including various fixed (or stationary) devices, workers and set forth, and more particularly to a production control system in a factory which can easily cope with a change in layout of the line and is suitable for the facilitation of a control for products to be physically distributed and a control for line structurization.

A processing line, an assembly line or the like in the building of a factory includes a multiplicity of objects including products to be flown along the line, various equipments for processing or assembling the products, and workers for handling the various equipments. Conventionally, the products flown along the line as well as containers and equipments for carrying the products are positionally recognized so that they are controlled. For example, see JP-A-2-176806.

In general, the recognition of position of each of moving bodies such as the products, the carrying containers and the carrying equipments (in particular, unmanned carrier cars) in the line is made by a method for an unmanned carrier car as an example in which the position thereof is recognized by using a floor reflecting tape, light, electric waves or the like and disposing a sensor at a fixed position to detect the passage of the carrier car and a method for a product, a pallet, a parts box or the like in which the position thereof is recognized by using a bar code, an IC card or the like and disposing a sensor at a fixed position to detect the passage of the object of interest. However, the fact for various equipments or devices such as assembling machines, processing machines or robots disposed at fixed positions and workers is that the position thereof is subjected to no recognition and hence no control. This results from the reason that those equipments are stationary though a parts of them (for example, robots) may be displaced and they have a low necessity of positional recognition, the reason that an increase/decrease in number and a positional movement are irregular as in the case of workers and the reason that the quantity of those equipments is large.

In the above-mentioned prior art, since the recognition of positions of various moving bodies such

as products relies upon methods which are different for the respective objects to be controlled, there is a problem that it is troublesome and difficult to systematically perform the recognition of positions of all of moving bodies, production equipments and the like on a floor.

In the existing line structurization, on the other hand, a small change in layout of a line is unavoidable in order to make it possible to cope with many-kind and small-quantity production and the change is required at a considerably high frequency. In order to satisfy this requirement, the recognition of positions of various equipments disposed at fixed positions and workers becomes necessary in addition to the recognition of positions of various moving bodies such as products and hence the positional recognition and control of all objects on a floor constructing the line becomes necessary. However, the prior art involves a problem that even in the case where the positional recognition and control of all objects on the floor is made, a change in layout of equipments or the like within the floor, if any, should be followed for a highly precise control by newly performing a positional recognition for each change. Also, the prior art has proposed no system which systematically makes the positional recognition and control of all objects on the floor.

An object of the present invention made in light of the above-mentioned problems of the prior art is to provide a production control system which easily enables the positional recognition and control of physically distributed equipments in a processing line, an assembly line or the like in a factory and physical-distribution related equipments including various fixed devices, workers and so on while making it possible to cope with a change in layout of the line.

To that end, according to a first aspect of the present invention, there is provided a production control system for controlling, in a factory, objects to be controlled which include products, parts for the products, moving bodies for carrying the products and the parts, and equipments for fabricating the products, comprising position recognizing means for recognizing the positions of at least the moving bodies and the equipments, a memory for storing production plan data for the products, and control means for comparing the positions of the moving bodies and the equipments recognized by the position recognizing means with the production plan data stored in the memory to transmit a control signal for position control to the moving bodies and the equipments on the basis of the result of comparison.

It is preferable that each of the objects to be controlled includes a worker having a receiver device

which receives the control signal from the control means.

Further, it is preferable that transmitters provided at a plurality of predetermined positions in the factory for transmitting codes inherent to the transmitters and position data representative of the positions of the transmitters in the factory are provided, each of the moving bodies and the equipments receives the codes and the position data from the transmitters, and the position recognizing means recognizes the positions of the moving bodies and the equipments on the basis of the codes and the position data from the transmitters received at each of the moving bodies and the equipments.

With such a construction, the positions of objects to be controlled including moving bodies, equipments and workers in a factory can be recognized always and the objects are controlled on the basis of the result of comparison of the recognized positions and production plan data. Therefore, it is possible to control the production of products always in accordance with the production plan data. Also, the present positions of the objects to be controlled are recognized. Therefore, even for a change in layout of a line, the objects to be controlled can be moved to positions after the change in layout in accordance with the above-mentioned control signal.

According to a second aspect of the present invention, there is provided a production control system in a space in a factory having objects to be controlled including physically distributed products and physical-distribution related equipments, comprising a plurality of transmitters which are disposed in the space and include transmitters respectively disposed at at least three positions on a floor in the space, the floor being applied with X, Y and Z coordinates beforehand, a receiver, an arithmetic circuit and a transmitter attached to each of moving bodies including products, among the objects to be controlled, which are carried in the factory, the receiver communicating with each of the transmitters disposed on the floor at every preset time, the arithmetic circuit sequentially determining the position coordinate of each moving body associated with the carriage thereof a communication between each of the transmitters and the receiver, the transmitter having a memory which is incorporated therein and has the code of each moving body stored therein, the transmitter transmitting the code and the determined position data, and a controller including a receiver which is capable of receiving coordinate data and codes of all of the objects to be controlled including the moving bodies through the transmitter and each of said transmitters disposed on the floor and a transmitter which recognizes the positions of all of the objects to be controlled by subjecting the data received by the receiver to

correspondence to the origin of coordinates set on the floor and is capable of transmitting a control signal for positionally controlling each moving body on the basis of the result of recognition.

Control based on positions of moving bodies.

According to a third aspect of the present invention, there is provided a production control system in a space in a factory having objects to be controlled including physically distributed products and physical-distribution related equipments, comprising a plurality of transmitters which are disposed in the space and include transmitters respectively disposed at at least three positions on a floor in the space, the floor being applied with X, Y and Z coordinates beforehand, a receiver and a transmitter attached to each of moving bodies including products, among the objects to be controlled, which are carried in the factory, the receiver communicating with each of the transmitters disposed on the floor at every preset time, the transmitter storing position data and a code of each moving body received by the receiver and outputting the stored data, and a controller including a receiver which is capable of receiving coordinate data and codes of all of the objects to be controlled including the moving bodies through the transmitter and each of the transmitters disposed on the floor, an arithmetic circuit for sequentially determining the position coordinate of each moving body associated with the carriage thereof on the basis of data received by the receiver, and a

transmitter which recognizes the position of each moving body by subjecting the determined coordinate data to correspondence to the origin of coordinates set on the floor and is capable of transmitting a control signal for position control on the basis of the result of recognition.

According to a fourth aspect of the present invention, there is provided a production control system in a space in a factory having objects to be controlled including physically distributed products and physical-distribution related equipments, comprising a plurality of receivers which are disposed in the space and include receivers respectively disposed at at least three positions on a floor in the space, the floor being applied with X, Y and Z coordinates beforehand, a transmitter attached to each of moving bodies including products, among the objects to be controlled, which are carried in the factory, the transmitter being capable of always transmitting a code and position data associated with carriage to each of the receivers disposed on the floor, a transmitter which is attached to each of the objects to be controlled other than the moving bodies and is capable of transmitting its own code and position data to each of the receivers disposed on the floor, a controller including an arithmetic circuit for receiving position data and codes of all of the objects to be controlled inclusive of the position data of each moving body from the transmitter through each of the receivers

disposed on the floor to sequentially determine the position coordinate of each moving body associated with the carriage thereof on the basis of the received data, and a transmitter which recognizes the position of each moving body by subjecting the determined coordinate data to correspondence to the origin of coordinates set on the floor and is capable of transmitting a control signal for position control on the basis of the result of recognition, and a receiver which is attached to each moving body and is capable of receiving the control signal from the transmitter provided in said controller.

The plurality of transmitters or receivers disposed in the space may further include at least one transmitter or receiver disposed at a position out of a plane defined by the at least three positions.

With the above construction, in the case of the present invention according to the second aspect in which a plurality of transmitters are disposed on a floor, the transmission from the plurality of transmitters are made periodically at every preset time to a receiver attached to each moving body such a product carried in the factory. Thereby, the position coordinate of each moving body associated with the carriage or transport thereof is sent through the receiver to an arithmetic circuit attached to each moving body and is subjected to sequential operation

therein. Position data obtained by the operation and the code of each moving body is inputted through the transmitter attached to the moving body to a receiver provided in a controller disposed on the floor. In this case, since position data and codes of various fixed equipments, workers and so on other than the moving bodies as well as the data of the moving bodies are inputted to the receiver provided in the controller through the plurality of transmitters disposed on the floor, the position data and codes of all of objects to be controlled are inputted. The inputted data is subjected to correspondence to the origin of coordinates set on the floor beforehand so that the positions of all of the objects to be controlled are recognized in accordance with the correspondence. On the basis of the recognized position data, a control signal for position control is outputted from the transmitter provided in the controller to the receiver attached to each moving body so that the carriage of the moving body is controlled to maintain a desired condition.

On the other hand, for a change in layout including the kinds of equipments associated with the carriage of different products and the positions of installation, position data and codes of various equipments, workers and so on, which are made the object of control after the change in layout, are inputted from the plurality of transmitters disposed on the floor to the receiver provided in the controller through the

communication between the receiver attached to each equipment or the like and the plurality of transmitters disposed on the floor and so on to subject the inputted data to correspondence to the origin of coordinates set on the floor. The position of each equipment or the like is newly recognized by this correspondence, thereby making it possible to easily cope with the change in layout. And, the carriage of each moving bodies can be maintained and controlled at a desired condition, as before the change in layout.

In the case of the present invention according to the third aspect in which a plurality of transmitters are disposed on a floor, the transmission from the plurality of transmitters are made periodically at every preset time to a receiver attached to each moving body, in a manner similar to that mentioned above. Thereby, the position data and code of each moving body associated with the carriage are received through a transmitter attached to the moving body to a receiver provided in a controller. In this case too, as in the invention according to the second aspect, the position data and codes of all of objects to be controlled are inputted to the receiver through the transmitter attached to each moving body and the plurality of transmitters disposed on the floor and the position coordinate of each moving body associated with the carriage thereof is sequentially operated or determined by an arithmetic circuit provided in a controller. The

position data of all of the objects to be controlled inclusive of the position data of the moving bodies obtained by the operation is subjected to correspondence to the origin of coordinates set on the floor beforehand so that the positions of all of the objects to be controlled are recognized in accordance with the correspondence. On the basis of the recognized position data, a control signal for position control is outputted from a transmitter provided in the controller to the receiver attached to each moving body so that the carriage of the moving body is controlled to maintain a desired condition.

An operation similar to that in the invention according to the second aspect is performed for a change in layout.

In the invention according to the fourth aspect in which a plurality of receivers are disposed on a floor, position data from a transmitter attached to each moving body such as a product carried in a factory and position data from a transmitter attached to an object to be controlled other than the moving body are transmitted to the plurality of receivers disposed on the floor. The transmitter attached to each moving body makes the transmission always and the transmitter attached to an object to be controlled other than the moving body makes the transmission, as required. Thereby, position data of each moving body associated with the carriage thereof and position data of an object

to be controlled other than the moving body are received by each receiver disposed on the floor. The received data is inputted from each receiver to an arithmetic circuit provided in a controller. On the basis of the inputted data, the arithmetic circuit sequentially determines the position coordinate of each moving body associated with the carriage thereof and determines the position coordinate of the object other than the moving body. The determined coordinate data is subjected to correspondence to the origin of coordinates set on the floor beforehand so that the positions of all of objects to be controlled are recognized in accordance with the correspondence. On the basis of the recognized position data, a control signal for position control is outputted from the transmitter provided in the controller to the receiver attached to each moving body so that the carriage of the moving body is controlled so that it is maintained at a desired condition.

For the change in layout, position data and codes of various equipments, workers and so on, which are made the object of control after the change in layout, are inputted from the plurality of receivers disposed on the floor to the arithmetic circuit provided in the controller through the communication between the plurality of receivers and the transmitters attached to the various equipments and so on to subject the inputted data to correspondence to the origin of coordinates set on the floor. The positions of the various equipments

and so on are newly recognized by the correspondence, thereby making it possible to easily cope with the change in layout. And, the carriage of each moving body can be maintained and controlled at a desired condition, as before the change in layout.

Since the coordinate positions of the the plurality of transmitters disposed on the floor in the inventions according to the second and third aspects become the bases for operation of the position data of objects to be controlled, there is the case where the correction of the positions are required at the time of a change in layout of a line or the like. Therefore, at least one fixed receiver for correction is provided at a known coordinate position on the floor and it is possible to operate or determine a distance between the fixed receiver for correction and each transmitter through the communication therebetween so that the coordinate positions of the plurality of transmitters can be corrected arbitrarily in accordance with the determined values.

The correction of the coordinate positions of the plurality of receivers disposed on the floor in the invention according to the fourth aspect is similar to the case of the inventions according to the second and third aspects but additionally requires the communication between the plurality of receivers and the fixed transmitter for correction provided at a known coordinate position on the floor.

In the drawings:

Figs. 1A and 1B are plan views showing an example of an equipment arrangement in a processing line in the building of a factory in a first embodiment of the present invention;

Fig. 2 is a perspective view of Figs. 1A and 1B;

Fig. 3 is a diagram for explaining a method for recognizing the position of a moving body such as a product;

Fig. 4A is a diagram showing an example of the construction of a controller in a second embodiment of the present invention;

Fig. 4B is a diagram showing an example of the construction of an object to be controlled in the second embodiment;

Fig. 5 shows an example of the codes of objects to be controlled and phase data from reference positions in a floor which are stored in the controller;

Fig. 6 is an example of a flow chart showing a control of the flow of products performed by the controller;

Fig. 7 shows an example of production plan data stored in the controller;

Fig. 8 shows an example of a work instruction outputted from the controller to an object to be controlled;

Fig. 9 shows an example of worker layout data stored in the controller;

Fig. 10 is a flow chart for explaining an example of an operation in which an instruction is made from the controller to a worker;

Fig. 11 is a flow chart showing an example of a control of an equipment by the controller;

Figs. 12A and 12B are plan views showing an example of an equipment arrangement in a processing line in the building of a factory in a third embodiment of the present invention;

Fig. 13 is a plan view showing an example of an equipment arrangement in a processing line for explaining recognition and control in three dimensions in the present invention; and

Fig. 14 is a cross section of Fig. 13 taken along line XIV-XIV.

A first embodiment of the present invention will be explained in reference to Figs. 1A, 1B, 2 and 3. Figs. 1A and 1B are plan views showing an example of an equipment arrangement in a processing line in the building of a factory. More particularly, Fig. 1A is a plan view of the first floor and Fig. 1B is a plan view of the ground floor. Fig. 2 is a perspective view of Figs. 1A and 1B, and Fig. 3 is a diagram for explaining a method for recognizing the position of a moving body.

In Figs. 1A and 1B, reference numeral 1 denotes the ground floor in the building of a factory which has a limited space partitioned off from the wall and the ceiling and numeral 2 denotes the first floor therein which has a similar space. The floors 1 and 2 are applied or set with XY coordinates. On the floors 1 and 2 are arranged moving bodies such as products which are objects to be controlled and are flown along a line, robots which handle the products and fixed bodies which are equipments such as production equipments for processing or assembling. Numeral 3 denotes a product flown by an unmanned carrier car along a line of the floor 1 in a direction indicated by arrow in Fig. 1B, and numeral 4 denotes a product flown by a belt conveyor or the like along a line of the floor 2 in a direction indicated by arrow in Fig. 1A. Usually, a multiplicity of products 3 and 4 are carried together with their containers or pallets.

Numeral 5 denotes transmitters disposed at three positions on the periphery of each of the floors 1 and 2 (preferably at least three positions) in order to determine the coordinate of an object to be controlled. The transmitter 5 transmits its own position coordinate and identification code which are inputted beforehand. Numeral 6 denotes a receiver (not shown) which is attached to each product 3 or 4 to communicate with each transmitter 5, for example, at each preset time. Numeral 7 denotes an arithmetic circuit (not shown) for

sequentially operating or determining the position coordinate of each product 3 or 4 associated with the carriage thereof on the basis of the position coordinate and code from each transmitter 5 through a communication of the receiver 6 with the transmitter 5. The arithmetic circuit 7 is attached to each product 3 or 4. Numeral 8 denotes a transmitter (not shown) which is attached to each product 3 or 4. The transmitter 8 includes therein a memory (not shown) in which an identification code of the product 3 or 4 is stored. The transmitter 8 is capable of transmitting the identification code stored in the memory and the position data determined by the arithmetic circuit 7. Though the receiver 6, the arithmetic circuit 7 and the transmitter 8 are attached to each product, they may be provided in a container or a pallet on which the product is placed.

Arithmetic circuit determines position data.

Numeral 9 denotes a controller disposed on each of the floors 1 and 2, and numeral 10 denotes a receiver provided in the controller 9. The receiver 10 is capable of receiving the coordinate data and code of each product 3 or 4 through the transmitter 8 and is also capable of receiving the coordinate data and code of each of various equipments 16 as objects to be controlled, which are arranged on the line, through a transmitter (not shown) attached to the equipment 16 and having a memory incorporated therein. Numeral 11 denotes a transmitter provided in the controller 9. The

transmitter 11 is capable of recognizing the positions of all objects to be controlled inclusive of the products 3 or 4 by subjecting data received by the receiver 10 to correspondence to the origin of the coordinates which are set on the floor 1 or 2 beforehand and is capable of transmitting a control signal for positional control of each product 3 or 4 to the receiver 6 on the basis of the result of recognition.

Numeral 12 denotes a fixed receiver for correction disposed at at least one predetermined position on each of the floors 1 and 2. The receiver 12 is capable of correcting the position of each transmitter 5 arbitrarily by determining a distance to the transmitter 5 on the basis of a communication with the transmitter 5. Numeral 13 denotes a plurality of workers arranged for the respective process steps, numeral 14 an elevator and numeral 15 a conveyor.

The operation of the above construction will now be explained.

Before the line operates, each object to be controlled, which includes the product 3 or 4, transmits to the receiver 10 of the controller 9 its own code and coordinate position which are stored beforehand in the memory included in that object. The dimensions of the floors 1 and 2 are respectively inputted to the controllers 9 to determine a reference coordinate (for example, center coordinate value) of each floor and this reference coordinate position is set as the origin of

coordinates of the floor 1 or 2. Each of the floors 1 and 2 is finely divided, for example, at every 1 cm, so that the floor is applied or set with coordinates.

After the start of the operation of the line, the product 3 or 4 becomes a main object to be recognized and controlled. When the transmission from each transmitter 5 is made periodically at every preset time to the receiver 6 attached to the product 3 or 4, the position coordinate of the product 3 or 4 associated with the carriage or transport thereof is sent through the receiver 6 to the arithmetic circuit 7 for sequential operation therein. Position data obtained by the operation and the code of the product 3 or 4 is inputted through the transmitter 8 to the receiver 10 provided in the controller 9. The inputted data is subjected to correspondence to the origin of coordinates on the floor 1 or 2 so that the position of the product 3 or 4 is recognized in accordance with the correspondence. On the basis of the recognized position data, a control signal for position control is outputted from the transmitter 11 to the receiver 6 attached to the product 3 or 4 so that the carriage of the product 3 or 4 is controlled to maintain a desired condition, for example, in such a manner that the position of the product is corrected in the case where it is deviated from a predetermined position.

AC determines posi'n

- 9 determines coordinates of product.

Since each product 3 or 4 is always placed at a condition monitored by the transmitters 5, the control

of the progress of the product 3 or 4 as well as the calculation of the order quantity of parts for assembly, the ordering time thereof and so on become easily possible with a far higher precision as compared with those in the conventional system based on only the number of delivery from the rack of a warehouse. The details of the construction of the moving body 3 or 4 and the controller 9 will be explained later on.

Next, a method for recognizing the position of a moving body such as the product 3 or 4 will be explained in reference to Fig. 3.

Now assume that the positions of the transmitters 5 disposed at three reference positions in the XY plane on the floor 1 or 2 are A, B and C and the position of a moving body is P. The coordinates of A, B and C are defined as A(-a, b), B(-a, -b) and C(a, -b). When electric waves are sent from the points A, B and C toward the point P, the arithmetic circuit 7 attached to the moving body determines the distances from the point P to the points A, B and C in accordance with the following equations (1) to (3):

$$\overline{PA} = \sqrt{(x + a)^2 + (y - b)^2} \quad \ldots (1)$$

$$\overline{PB} = \sqrt{(x + a)^2 + (y + b)^2} \quad \ldots (2)$$

$$\overline{PC} = \sqrt{(x - a)^2 + (y + b)^2} \; . \quad \ldots (3)$$

A curve when a difference between the distances PA and PB obtained by the above equations (or

a difference in phase of electric waves) is constant, is represented by the following equation (4) and is Line 1 shown by dotted line in Fig. 3. Namely, the equation (Line 1) when $\overline{PA} - \overline{PB}$ = constant,

$$\frac{(x+a)^2}{\alpha} - \frac{y^2}{\beta^2} = 1 \quad (\alpha,\ \beta\text{: constant}).\ \ldots\ (4)$$

Similarly, a curve when a difference between the distances PB and PC is constant, is represented by the following equation (5) and is Line 2 shown by chained line in Fig. 3. Namely, the equation (Line 2) when $\overline{PB} - \overline{PC}$ = constant,

$$\frac{x^2}{\gamma} - \frac{(y+b)^2}{\delta} = 1 \quad (\gamma,\ \delta\text{: constant}).\ \ldots\ (5)$$

The coordinate of the point P can be obtained by determining the coordinate of the intersection of the curves represented by the equations (4) and (5). In the present invention, it is possible to measure at the point P to 1/10 phase of the wave length when using electromagnetic wave of 1 GHz. In this case, the precision of measurement is about 3 cm, the precision of measurement can be further improved, if the electromagnetic wave with a higher frequency is used, if the precision of measurement of the phase is improved, if local coordinates are used, or if positional recognition by a laser beam is made, or the like.

In the case where three-dimensional coordinates including a Z coordinate in addition to the above-mentioned X, Y coordinates are to be determined, an additional (fourth) transmitter 5 may be disposed in the direction of Z-axis on the floor 1 or 2 to determine the coordinate P of the intersection of three curved surfaces, that is, a first curved surface obtained from differences of distances from the first and second transmitters, a second curved surface obtained from differences of distances from the second and third transmitters, a third curved surface obtained from differences of distances from the third and fourth transmitters. The determination of the coordinate of each moving body is not limited to the disclosed method. Another known method can be used.

The determined coordinate of the point P is inputted through the transmitter 8 to the receiver 10 of the controller 9 in which it is subjected to correspondence to the origin of coordinates on the floor 1 or 2, thereby recognizing the position of the point P.

In the present invention mentioned above, since all products flown along the line can be recognized and controlled, it is possible to surely confirm the positions and quantity of products even in the case where inferiority is found out in the product 3 or 4 or in the case where products are removed from the line, for example, in the case where partially fabricated items are yielded due to the deficiency of

parts for assembly. In the case of an inferior product, inferiority information is stored into a memory of a transmitter 8 attached to the product, thereby making it possible to surely prevent the inferior product from entering a group of good products. Thus, it becomes possible to immediately cope with various situations on the line of each product.

On the other hand, for a change in layout including the kinds of equipments associated with the carriage of different products and the positions of installation, position data and codes of various equipments 16, workers 13 and so on, which are made the object of control after the change in layout, are inputted from the transmitters 5 disposed on the floor 1 or 2 to the receiver 10 of the controller 9 through the communication between the transmitters and receivers attached to the various equipments 16 and so on to subject the inputted data to correspondence to the origin of coordinates on the floor 1 or 2. This correspondence to the origin can be taken easily and simply and the positions of the various equipments 16 and so on after the change in layout are newly recognized by the correspondence, thereby making it possible to easily cope with the change in layout. And, the carriage of individual moving bodies including the products 3 or 4 can be maintained and controlled at a desired condition, as before the change in layout.

Next, a second embodiment of the present invention will be explained by use of Figs. 1A and 1B, Fig. 2 and Figs. 4 to 11. The construction of the second embodiment is similar to that of the first embodiment but is different therefrom in that all the arithmetic circuits 7 attached to moving bodies such as the products 3 or 4 in the first embodiment are there- instead provided in the controller 9. AC 7 in 9

In the present embodiment, the transmission from each transmitter 5 is made periodically at every preset time to a receiver 6 attached to each moving body such as a product 3 or 4 in a manner similar to that in the first embodiment. Thereby, the position data and code of the product 3 or 4 or the like associated with the carriage are received through a transmitter 8 to a receiver 10 provided in a controller 9. The receiver 10 is inputted with the position data and codes of all objects to be controlled, as in the first embodiment, and the position coordinate of each product 3 or 4 or the like associated with the carriage thereof is sequentially operated or determined by an arithmetic circuit 7 provided in the controller 9. The position data of all of the objects to be controlled inclusive of the position data of each product 3 or 4 obtained by the operation is subjected to correspondence to the origin of coordinates set beforehand on the floor 1 or 2 so that the positions of all of the objects to be controlled are recognized in accordance with the

correspondence. On the basis of the recognized position data, a control signal for position control is outputted from a transmitter 11 provided in the controller 9 to the receiver 6 attached to each product 3 or 4 or the like so that the carriage of the product 3 or 4 or the like is controlled to maintain a desired condition.

Next, a method for controlling the product 3 or 4 in the present embodiment will be explained in reference to Figs. 4A and 4B and Figs. 5 to 11. Fig. 4A is a diagram showing an example of the construction of the controller in the present embodiment, Fig. 4B is a diagram showing an example of the construction of an object to be controlled in the present embodiment, Fig. 5 shows an example of the codes of objects to be controlled and phase data from reference positions in a floor which are stored in the controller, Fig. 6 is an example of a flow chart showing a control of the flow of products performed by the controller, Fig. 7 shows an example of production plan data stored in the controller, Fig. 8 shows an example of a work instruction outputted from the controller to an object to be controlled, Fig. 9 shows an example of worker layout data stored in the controller, Fig. 10 is a flow chart for explaining an example of an operation in which an instruction is made from the controller to a worker, and Fig. 11 is a flow chart showing an example of a control of an equipment by the controller.

Each object 3 or 4 to be controlled has a memory 31, a receiver 6 and a transmitter 8, as shown in Fig. 4B. As in the first embodiment, the code of the object to be controlled is beforehand inputted to the memory 31 through an input terminal 32 of an input device 33. Phase data and codes of the reference positions inputted through the receiver 6 are also stored in the memory 31. Those data are read and are then sent to the controller 9 through the transmitter 8.

On the other hand, the controller 9 includes a receiver 10, a transmitter 11, a CPU (or central processing unit) 100, an arithmetic circuit 7, an input/output (I/O) board (or I/O circuit) 101 and a memory device 102, as shown in Fig. 4A. The memory device 102 has production plan data 103 and layout data 108 which are stored, for example, by a manager from an input device 35 through the I/O circuit 101 and a bus 37, for example, at the time of commencement of daily work or at the time of change in layout.

The production plan data 103 is composed of data including kind (or type) 210, throughput 212, process 213, target throughput 214 and so on, as an example is shown in Fig. 7. The kind data 210 is, for example, data representing the kind of a product (by a code in Fig. 7). The throughput data 212 is data representing a target (or scheduled) throughput and an actual throughput of products of the same kind in a fixed period of time, for example, until the present

instant of time of this day. The process data 213 is data representing a fabrication process of products. In an example shown in Fig. 7, the process data 213 has coordinate data 215 of a start portion of each of three process steps (for example, nine digits in a hexadecimal notation) and a scheduled instant 216 at which the product reaches the start portion of the process step. The scheduled instant may be a scheduled instant for the first one of a series of products of the same kind or a scheduled instant for each of those products. In the latter case, the code of each product is recognized for comparison with the scheduled instant for that product. The target throughput data 214 is a target throughput 219 of the same kind of products, for example, per one day.

The layout data 108 manages data of equipment 109 and worker 110. As shown in Fig. 5, an object to be controlled (product, worker, production equipment and so on) is managed as data 201 (for example, six digits in the hexadecimal notation) which represents the code of the object and phase data 202 (for example, nine digits) which is position data of the object. These data are stored in the memory device 102. For the purpose of simplification, data of only one for each of the product, worker and production equipment is shown in Fig. 5. However, if there are a plurality of products, workers and production equipments, their respective data are managed.

The code 201 is composed of a kind number 203 and a reference number 204. The phase data 201 represents phase data (205, 206, 207) of three digits in the hexadecimal notation transmitted from three points A, B and C on a floor.

A method for management and control of those data in the controller 9 will be explained using Fig. 6. Data transmitted from objects to be controlled or products 3 or 4 include code and phase data shown in Fig. 5. These data are received by the receiver 10 (step 121) and the positions are thereafter operated or determined and recognized in accordance with the method explained in conjunction with Fig. 3 (step 122). The recognized position data is managed as layout data 108. Fig. 9 shows an example of worker layout data. Equipments are also managed in a similar manner. On the other hand, position data of products is stored in the memory 102. The position data 203 of products among the recognized position data is compared with production plan data 103 in the memory device 102, in particular, data of throughput 212, process 213 and target throughput 214 (step 122) for comparison with the scheduled values (step 123). The comparison is made in such a manner that the position data 203 of the corresponding product is compared with the coordinate of a start portion of each process step to judge whether or not the product has reached the step and an instant when the product reaches is compared with the corresponding

9 determines position

scheduled instant. For example, if an instant when the corresponding product reaches a start portion of the corresponding step (for example, step A) is before the scheduled instant 8:40, the judgement of the product flow as being earlier than the schedule is made so that the entry of a predetermined symbol, for example, ○ is made in an actual column 217 indicating the progress condition of the product in the step A (step 123). If the instant of interest is after the scheduled instant, the judgement of the product flow as being later than the schedule is made so that the entry of a symbol × is made in the actual column 217 (step 123). Accordingly, the example shown in Fig. 7 shows that the product flow is earlier than the schedule in the case of the steps A and B and is later than the schedule in the case of the step C.

In a step in which the flow is earlier than the schedule, instruction data for suppressing the input of products to this step is given to workers and/or equipments through the transmitter 11 on the basis of the above result (step 125).

The instruction data includes data representing an identification code of a receiver of the instruction data and the contents of instruction, as shown in Fig. 8. The data is represented by, for example, a series of numerals in the hexadecimal notation. The instruction data may further include position data of the receiver. The identification code

(or position data) is read from the layout data shown in Fig. 8. Various instruction data may be stored in the memory device 102 beforehand so that one data is selectively read therefrom. Thereby, the instruction data is received by a worker or an equipment corresponding to the read code. For the worker, a warning or the like may be issued in accordance with the instruction, for example, to a monitor carried by the worker or a message according to the instruction may be displayed on the monitor. For the equipment, the input of products to the process step is suppressed in accordance with the instruction.

In a step in which the flow is later than the schedule (step 127), instruction data is given to the corresponding workers and/or equipments in order to input products to the corresponding step (steps 129 and 130) or instruction data is given to a superintendent of the corresponding line to input workers and/or equipments to the corresponding step.

Whether the flow of products is earlier or later than the schedule may be judged by comparing a scheduled value 220 and an actual value 221 of the throughput 212 of the same kind of products at the present point of time. In this case, the judgement is made in accordance with whether the throughput of products at the present point of time (or the actual value) is larger or smaller than the scheduled value. If the actual value is larger than the scheduled value,

an instruction for suppression of the input of products is issued to workers and/or equipments present in the start portion of the line in a manner similar to that in steps 125 and 130. If the actual value is smaller than the scheduled value, the process step including the late product flow is listed up (step 128) and an operation similar to that in steps 129 and 130 is performed. Thereby, the control of products on the floors 1 and 2 is performed.

Next, a method for control of workers in the controller 9 will be explained using Fig. 10. As mentioned above, phase data of a worker is received by the receiver 10 (step 131) and the position thereof is then determined and recognized by the arithmetic circuit 7. The recognized position data is stored as the present position for layout data 108 in the memory device 102 shown in Fig. 4A and is compared with an arrangement position in the layout data 108 (step 132). The worker layout data is represented as the code 231, the arrangement position 232 and the present position 233 of each of workers of that day, as shown in Fig. 9. The arrangement position is a set position for that day. Each data is represented in the hexadecimal notation. The worker code, the arrangement position data and the present position data are represented by, for example, six digits, nine digits and nine digits, respectively. The arrangement position data 232 and the present position data 233 are compared with each other. If both

the data are the same, a predetermined symbol, for example, ○ is stored as the result of judgement. If both the data are different from each other, a symbol × is stored as the result of judgement. The results of judgement are displayed on a display device 38 (see Fig. 4A). In this manner, the positions of workers are checked (step 133). In the case where a worker is present at a place different from the arrangement position, data as shown in Fig. 8 is transmitted to the worker to instruct the worker to return to the original arrangement position (step 135). The instruction for movement to a worker can be made accurately in such a manner that the worker can see an instruction from the controller by means of the above-mentioned monitor, a pocket bell with display function or the like. Thus, the control of workers on the floors 1 and 2 is performed.

A method for control of equipments will now be explained using Fig. 11. Position data of an equipment is received by the receiver 10 (step 141) and the position thereof is then determined and recognized by the arithmetic circuit 7. The recognized position data is stored as the present position for layout data 108 in the memory device 102 shown in Fig. 4A and the layout data is compared with production plan data 103 (step 142) to check the position of the equipment (step 143). In the case where the equipment is present at a place different from an arrangement position set in the memory

device, present place data and work instruction data for that equipment as shown in Fig. 8 is transmitted to a superintendent of the line (step 145). In the case where the flow of products is not normal, the conditions of abnormality is memorized (step 146). If the conditions of abnormality occur many times, information of a troublesome equipment is transmitted to the superintendent of the line to instruct the superintendent to make a change in layout (step 148).

By combining the above-mentioned control methods, it becomes possible to make the simultaneous control of products, workers and equipments.

The change in layout may be similar to that in the first embodiment.

Next, a third embodiment of the present invention, in which a plurality of receivers are disposed on the floor 1 or 2, will be explained in reference to Figs. 12A and 12B. Figs. 12A and 12B are plan views showing an example of an equipment arrangement in a processing line in the building of a factory. More particularly, Fig. 12A is a plan view of the first floor and Fig. 12B is a plan of the ground floor. In Figs. 12A and 12B, the same components as those in Figs. 1A and 1B are designated by the same reference numerals as those used in Figs. 1A and 1B.

In Figs. 12A and 12B, numeral 20 denotes receivers disposed at three positions on the periphery of each of the floors 1 and 2. The number of disposal

positions of the receivers 20 is at least three in order to determine the coordinate of an object to be controlled. Numeral 21 denotes a transmitter (not shown) which is attached to each moving body such as a product 23 or 24 or the like flown along a line on the floor 1 or 2. The transmitter 21 can always transmit a code and its own position data associated with the carriage thereof to each receiver 20. An object to be controlled other than the moving body is attached with a transmitter (not shown) which can transmit a code and its own position data associated with the carriage thereof to each receiver 20. Numeral 22 denotes a transmitter (not shown) which is attached to each product 3 or 4.

Numeral 25 denotes a controller disposed on each of the floors 1 and 2. Numeral 26 denotes an arithmetic circuit provided in the controller 25. The arithmetic circuit 26 sequentially determine the position coordinate of each product 23 or 24 or the like associated with the carriage thereof on the basis of the position coordinate and a code from the transmitter 21 and the transmitter of the object to be controlled other than the moving body received through each receiver 20. Numeral 27 denotes a transmitter provided in the controller 25. The transmitter 27 is capable of recognizing the positions of objects to be controlled inclusive of the products 23 or 24 or the like by making the correspondence of the operated coordinate data to

the origin of the coordinates set on the floor 1 or 2 beforehand and is capable of transmitting a control signal for positional control of each product 23 or 24 or the like to the receiver 22 on the basis of the result of recognition.

Numeral 28 denotes a fixed transmitter for correction disposed at at least one predetermined position on each of the floors 1 and 2. The transmitter 28 is capable of correcting the position of each receiver 20 arbitrarily by operating a distance to the receiver 20 on the basis of a communication with the receiver 20.

The operation of the present embodiment will now be explained.

Before the line operates, position data from the transmitter 21 attached to each moving body such as the product 23 or 24 or the like and position data from the transmitter attached to an object to be controlled other than the moving body are transmitted to the receivers 21 disposed on the floor 1 or 2. The transmitter 21 makes the transmission always and the transmitter attached to an object to be controlled other than the moving body makes the transmission, as required. The setting of the origin of coordinates on the floor 1 or 2 and the application of coordinates to the floor 1 or 2 with the origin taken as a reference are made in a manner similar to that in the foregoing embodiments.

After the start of the operation of the line, position data of each moving body such as the product 23 or 24 or the like associated with the carriage thereof and position data of an object to be controlled other than the moving body are received by each receiver 20 disposed on the floor 1 or 2. The received data is inputted from the receiver 20 to the arithmetic circuit 26. On the basis of the inputted data, the arithmetic circuit 26 sequentially determines the position coordinate of each product 23 or 24 or the like associated with the carriage thereof and determines the position coordinate of the object other than the moving body. The determined coordinate data is subjected to correspondence to the origin of coordinates on the floor 1 or 2 so that the positions of all objects to be controlled are recognized in accordance with the correspondence. On the basis of the recognized position data, a control signal for position control is outputted from the transmitter 27 of the controller 25 to the receiver 22 attached to each product 3 or 4 or the like so that the carriage of the moving body such as the product 3 or 4 is controlled so that it is maintained at a desired condition.

For a change in layout of various equipments 16 and so on, position data and codes of various equipments 16, workers 13 and so on, which are made the object of control after the change in layout, are inputted from the receivers 20 disposed on the floor 1

or 2 to the arithmetic circuit 26 of the controller 25 through the communication between the receivers 20 and the transmitters attached to the various equipments 16, the workers and so on to subject the inputted data to correspondence to the origin of coordinates on the floor 1 or 2. The positions of the various equipments 16 and so on after the change in layout are newly recognized by the correspondence, thereby making it possible to easily cope with the change in layout. And, the carriage of individual moving bodies including the products 23 or 24 or the like can be maintained and controlled at a desired condition, as before the change in layout.

Since the coordinate positions of the transmitters 5 disposed on the floor 1 or 2 in the first and second embodiments become the bases for operation of the position data of objects to be controlled, there is the case where the correction of the positions are required at the time of a change in layout of a line or the like. Therefore, at least one fixed receiver 12 for correction is provided at a known coordinate position on each of the floors 1 and 2 and it is possible to operate or determine a distance between the fixed receiver 12 for correction and each transmitter 5 through the communication therebetween so that the coordinate position of each transmitter 5 can be corrected arbitrarily in accordance with the determined value. In the case where only the height of the transmitter 5 is changed, one receiver suffices. In the case where the position of

the transmitter 5 in a plane is changed, at least three receivers are required.

The correction of the coordinate position of each receiver 20 disposed on the floor 1 or 2 in the third embodiment is similar to the case of the first and second embodiments but additionally requires the communication between each receiver 20 and a fixed transmitter 28 for correction provided at a known coordinate position on each of the floors 1 and 2.

The recognition and control of physical distribution in an XY plan have been explained in conjunction with the foregoing embodiments. Next, the recognition and control in three dimensions additionally including an XZ or YZ plane on the same floor will be explained in reference to Figs. 13 and 14. Fig. 13 is a plan view showing an example of an equipment arrangement in a processing line for explaining the recognition and control in three dimensions in the present invention, and Fig. 14 is a cross section of Fig. 13 taken along line XIV-XIV. In Figs. 13 and 14, the same components as those in Figs. 1A, 1B and 2 are designated by the same reference numerals as those used in Figs. 1A, 1B and 2.

In Figs. 13 and 14, reference numeral 17 denotes a conveyor arranged at a ceiling and numeral 33 denotes moving bodies including a plurality of products which are carried in a building by the conveyor 17 so that they are movable in an upward/downward direction.

Numeral 30 denotes transmitters disposed on an XZ or YZ wall surface of a floor 1 which are applied with coordinates beforehand. In order to determine the Z-direction coordinate of an object to be controlled, the transmitters are arranged at at least two positions to correspond to transmitters 5 disposed at three positions on the floor 1. As in the embodiment shown in Figs. 1A and 1B, a receiver 6, an arithmetic circuit 7 and a transmitter 8 (not shown) are attached to each moving body 33. Also, a controller 9 including a receiver 10 and a transmitter 11 provided therein and a fixed receiver 12 for correction are disposed on the floor 1, as in the embodiment shown in Figs. 1A and 1B.

The operation of the above construction is the same as that in the embodiment shown in Figs. 1A and 1B, excepting that Z-direction coordinate data of the moving body 33 determined by each transmitter 30 is added to XY-plane coordinate data of the moving body determined by each transmitter 5 and a three-dimensional position control signal is substituted for a two-dimensional position control signal in the embodiment shown in Figs. 1A and 1B. Accordingly, the positional recognition of the moving body 33 in three dimensions becomes possible and the carriage of the moving body 33 making a movement in three dimensions can be maintained and controlled easily at a desired condition.

As has been explained in the foregoing, a production control system according to the present

invention provides an effect that the system enables the easy and highly-precise positional recognition and control of physically distributed equipments in a processing line, an assembly line or the like in the building of a factory and physical-distribution related equipments including various fixed devices, workers and set forth, and an effect that the system can easily cope with a change in layout of the line.

Now, the aforesaid embodiment may be modified such that the transmitters 5 or receivers 20 may be disposed at least three positions in the space defined by the X, Y and Z coordinates. Further, the plurality of transmitters or receivers disposed in the space may further include at least one transmitter or receiver disposed at a position out of a plane defined by the at least three positions.

Furthermore, the communication among the transmitters and the receivers may be performed by using optical communication.

CLAIMS

1. A production control system for controlling, in a factory, objects to be controlled which include products, parts for the products, moving bodies for carrying the products and the parts, and equipments for fabricating the products, comprising:

position recognizing means for recognizing the positions of at least said moving bodies and said equipments;

a memory for storing production plan data for said products; and

control means for comparing the positions of said moving bodies and said equipments recognized by said position recognizing means with said production plan data stored in said memory to transmit a control signal for position control to said moving bodies and said equipments on the basis of the result of comparison.

2. A production control system according to Claim 1, wherein each of said objects to be controlled includes a worker having a receiver device which receives the control signal from said control means.

3. A production control system according to Claim 1, further comprising transmitters provided at a plurality of predetermined positions in the factory for transmitting codes inherent to said transmitters and position data representative of the positions of said transmitters in the factory, each of said moving bodies

and said equipments receiving the codes and the position data from said transmitters, said position recognizing means recognizing the positions of said moving bodies and said equipments on the basis of the codes and the position data from said transmitters received at each of said moving bodies and said equipments.

4. A production control system in a space in a factory having objects to be controlled including physically distributed products and physical-distribution related equipments, comprising:

a plurality of first transmitters respectively disposed at at least three positions on a floor in said space, said floor being applied with X, Y and Z coordinates beforehand;

a first receiver, an arithmetic circuit and a second transmitter attached to each of moving bodies including products, among said objects to be controlled, which are carried in the factory, said first receiver communicating with each of said first transmitters disposed on said floor at every preset time, said arithmetic circuit sequentially determining the position coordinate of each moving body associated with the carriage thereof a communication between each of said first transmitters and said first receiver, said second transmitter having a memory which is incorporated therein and has the code of each moving body stored therein, said second transmitter transmitting said code and the determined position data; and

a controller including a second receiver which is capable of receiving coordinate data and codes of all of said objects to be controlled including said moving bodies through said second transmitter and each of said first transmitters disposed on said floor and a third transmitter which recognizes the positions of all of the objects to be controlled by subjecting the data received by said receiver to correspondence to the origin of coordinates set on said floor and is capable of transmitting a control signal for positionally controlling each moving body on the basis of the result of recognition.

5. A production control system according to Claim 4, further comprising a fixed receiver for correction disposed at a predetermined coordinate position on said floor for determining a distance from each of said first transmitters disposed on said floor through a communication with the first transmitter to arbitrarily correct the position of each of said first transmitters.

6. A production control system in a space in a factory having objects to be controlled including physically distributed products and physical-distribution related equipments, comprising:

a plurality of first transmitters respectively disposed at least three positions on a floor in said space, said floor being applied with X, Y and Z coordinates beforehand;

a first receiver and a second transmitter attached to each of moving bodies including products, among said objects to be controlled, which are carried in the factory, said receiver communicating with each of said first transmitters disposed on said floor at every preset time, said second transmitter storing position data and a code of each moving body received by said first receiver and outputting the stored data; and

a controller including a second receiver which is capable of receiving coordinate data and codes of all of said objects to be controlled including said moving bodies through said second transmitter and each of said first transmitters disposed on said floor, an arithmetic circuit for sequentially determining the position coordinate of each moving body associated with the carriage thereof on the basis of data received by said second receiver, and a third transmitter which recognizes the position of each moving body by subjecting the determined coordinate data to correspondence to the origin of coordinates set on said floor and is capable of transmitting a control signal for position control on the basis of the result of recognition.

7. A production control system according to Claim 6, further comprising a fixed receiver for correction disposed at a predetermined coordinate position on said floor for determining a distance from each of said first transmitters disposed on said floor through a

communication with the first transmitter to arbitrarily correct the position of each of said first transmitters.

8. A production control system in a space in a factory having objects to be controlled including physically distributed products and physical-distribution related equipments, comprising:

a plurality of first receivers respectively disposed at at least three positions on a floor in said space, said floor being applied with X, Y and Z coordinates beforehand;

a first transmitter attached to each of moving bodies including products, among said objects to be controlled, which are carried in the factory, said first transmitter being capable of always transmitting a code and position data associated with carriage to each of said receivers disposed on said floor;

a second transmitter which is attached to each of the objects to be controlled other than said moving bodies and is capable of transmitting its own code and position data to each of said first receivers disposed on said floor;

a controller including an arithmetic circuit for receiving position data and codes of all of said objects to be controlled inclusive of the position data of each moving body from said first transmitter through each of said first receivers disposed on said floor to sequentially determine the position coordinate of each moving body associated with the carriage thereof on the

basis of the received data, and a third transmitter which recognizes the position of each moving body by subjecting the determined coordinate data to correspondence to the origin of coordinates set on said floor and is capable of transmitting a control signal for position control on the basis of the result of recognition; and

a second receiver which is attached to each moving body and is capable of receiving the control signal from said third transmitter provided in said controller.

9. A production control system according to Claim 8, further comprising a fixed receiver for correction disposed at a predetermined coordinate position on said floor for determining a distance from each of said first receivers disposed on said floor through a communication with the first receiver to arbitrarily correct the position of each of said first receivers.

10. A production control system according to Claim 4 or 6, wherein said plurality of transmitters disposed in said space further include at least one transmitter disposed at a position out of a plane defined by said at least three positions.

11. A production control system according to Claim 8, wherein said plurality of receivers disposed in said space further include at least one receiver disposed at a position out of a plane defined by said at least three positions.

12. A production control system substantially as herein described with reference to and as illustrated in Figs. 1 to 3, Figs. 4 to 11 or Figs. 12 to 14 of the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(e˙ rch report)

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Documents considered relevant following a search in respect of Claims :-
1-3

Relevant Technical Fields

(i) UK Cl (Ed.M) G3N (NGBX, NGBC2, NGBC6, NGBA, NG2, NGA3, NGE2, NGE2B, NGBA1)

(ii) Int Cl (Ed.5) G05B AND G05D

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2215870 A	(AMADA) see page 2, pages 10-11 and Figure 4 for example	1
X	EP 0411498 A2	(KERNFORSCHUNGSZENTROM KARLSRUHE GMBH) see Figure 1 and WPI Abstract Accession No 91-038421/06	1
X	EP 0190742 A2	(HITACHI)	1

Databases:The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).